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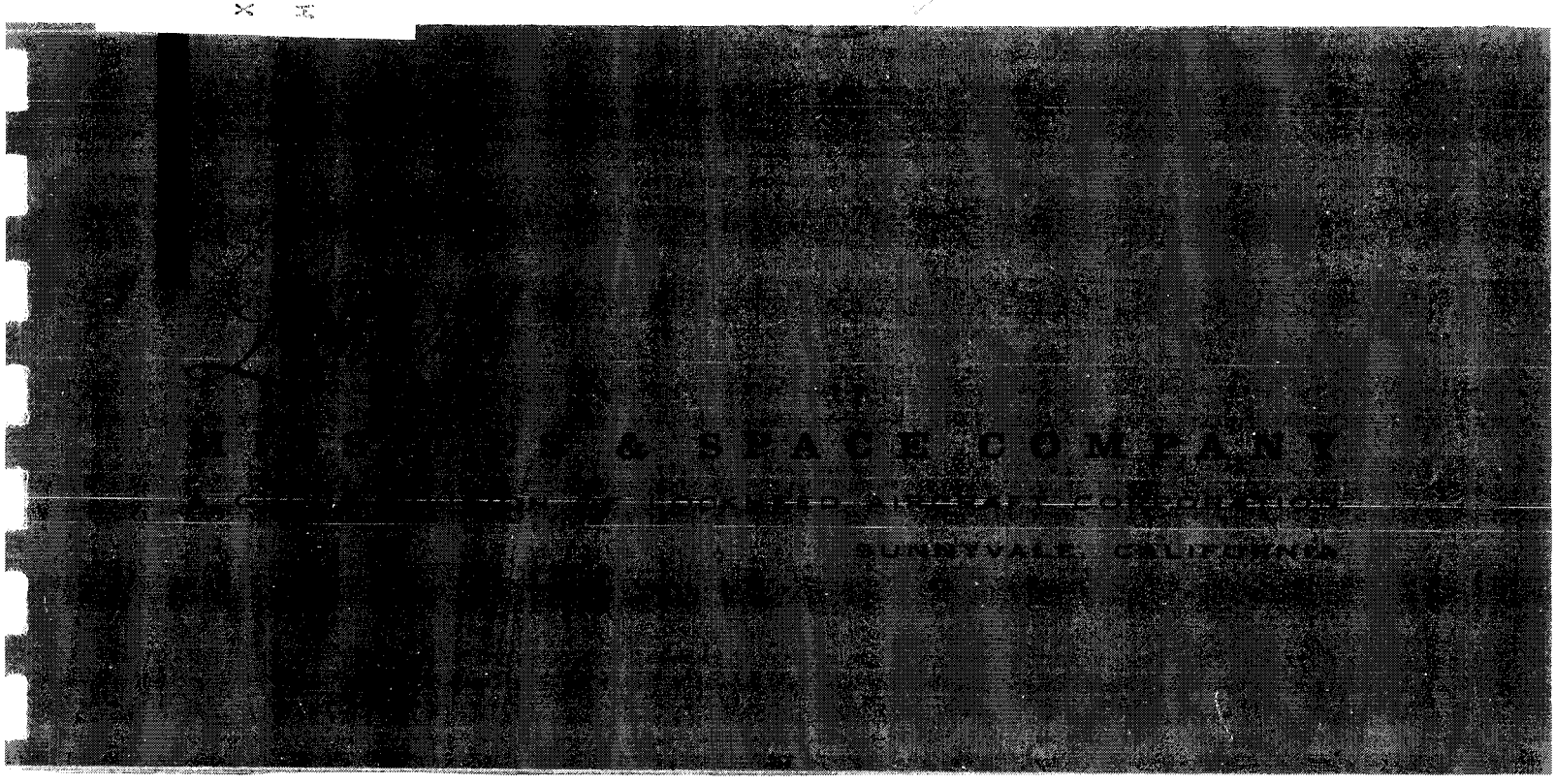
RIFT QUALITY ASSURANCE PROGRAM PLAN

DSD 408 Contract No. NAS 8-5600
and Contract No. 8-9500

OTS PRICE
XEROX $
MICROFILM $



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RIFT QUALITY ASSURANCE PROGRAM PLAN

DSD 408 Contract No. NAS 8-5600
and Contract No. 8-9500

Approved L. L. Woodward

L. L. WOODWARD, Manager
LSVP Test Operations

H. F. Plank

H. F. PLANK, Director
Large Space Vehicle Programs

Lockheed

MISSILES & SPACE COMPANY

A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION

SUNNYVALE, CALIFORNIA

FOREWORD

This report constitutes the terminal Quality Program Plan. It incorporates the comments received from NASA/MSFC, LMSC/A334824, dated 6 May 1963, concerning the first submission of the RIFT Quality Program Plan.

Appendix A is an up-to-date list of the Product Assurance procedures peculiar to RIFT which provide basic procedural coverage in accordance with NASA document NPC 200-2, Quality Program Provisions for Space System Contractors. Current LMSC Product Assurance procedures will be submitted to NASA for review on an individual basis prior to application to the RIFT Program.

Appendix B is a typical list of miscellaneous small parts, and other parts and materials, which cannot be serialized or otherwise identified after fabrication or incorporation into a serialized assembly.

Appendix C is the Product Assurance Standard, "Supplier Product Assurance System Requirements," PA STD 5-1.0, dated 18 Nov 1963.

CONTENTS

ILLUSTRATIONS

ABBREVIATIONS

ADA	Automatic Data Acquisition
AMR	Atlantic Missile Range
CART	Condition of Acceptance and Release for Transfer
CCC	Checkout Coordination Committee
CFAT	Cold-Flow Acceptance Test
CFF	Cold-Flow Facility
CO	Checkout
CS	Cold Soak
DRCB	Design Release Control Board
FSI	Functional Systems Installation
GFP	Government-Furnished Property
GSE	Ground Support Equipment
LMSC	Lockheed Missiles & Space Company
LOL	Limited Operating Life
MPS	Manufacturing Process Standard
MRB	Material Review Board
MSFC	Marshall Space Flight Center
MSP	Miscellaneous Small Part
NASA	National Aeronautics and Space Agency
NRDS	Nuclear Rocket Development Station
NSP	Nuclear Space Programs (Branch of Space Programs Division, LMSC)
PA	Product Assurance
PCN	Process Control Number
PTF	Propellant Tank Fabrication (facility)
QA	Quality Assurance

QDR	Quality Data Record
QPP	Quality Program Plan
RIFT	Reactor-In-Flight-Test
SCL	Supplies Check List
S-N	Stage – Nuclear
S-N-D	Stage – Nuclear – Dynamics
STE	Special Test Equipment
TA	Test Article

Section 1
INTRODUCTION

1.1 GUIDELINES

The Quality Program Plan (QPP), which the Nuclear Space Programs (NSP) of Lockheed Missiles & Space Company (LMSC) is formulating, establishes guidelines to assure conformance of the quality program requirements set forth in Contract NAS 8-5600. This plan delineates (1) control of quality, inspection, and test functions and (2) the responsibilities considered necessary to accomplish the following major objectives:

- Assurance that emphasis is placed on maintenance of quality and reliability by the use of (a) the latest engineering drawings and specifications, (b) data relating to manufacturing and testing capability, and (c) feedback from inspection records
- Assurance that all materials, parts, and assemblies conform to contractual requirements and that the intent of design will be maintained throughout all phases of contract performance
- Assurance that quality program requirements are satisfied and that the product is inherently capable of conforming to the performance standards established by NSP Design Engineering and approved by Marshall Space Flight Center (MSFC)
- Assurance of submission of the Quality Program documentation required by Appendix B of NASA document NPC 200-2, Quality Program Provisions for Space System Contractors

The following definitions are appropriate to this discussion:

- NSP Product Assurance is defined as the coordination of all quality assurance, reliability, and safety organization activities to provide product integrity.

- NSP Quality Assurance is defined as the coordination of quality control, inspection, fabrication test, and checkout personnel functions and requirements in accordance with NPC 200-2.

1.2 SCOPE

This Quality Program Plan is intended to ensure that quality requirements are established and satisfied throughout all phases of contract performance, including:

(1) Engineering design and development
(2) Manufacturing
(3) Testing
(4) Shipping
(5) Flight operations
(6) Flight data analysis

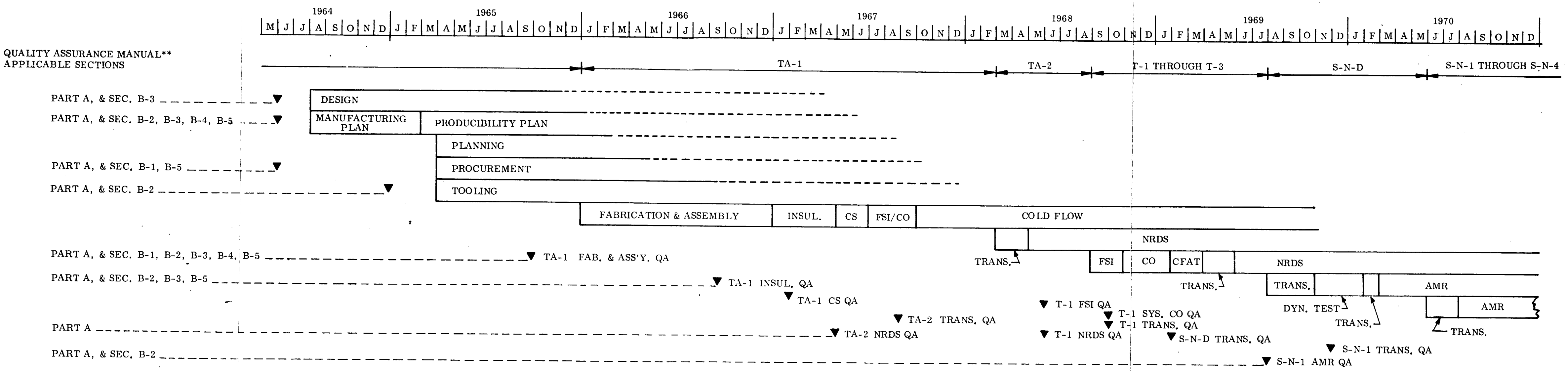
As outlined herein, the QPP policies and procedures are planned to assure quality and reliability in design and to aid in achieving the required reliability of space system components and ground support equipment and system installations.

1.3 REVISIONS

This document will be revised on an unscheduled basis to include improved methods of quality control and newly developed inspection techniques that can be applied to the manufacture and test of parts and assemblies. Such revisions will be submitted to MSFC for review four weeks prior to incorporation in the QPP.

1.4 PROGRAM SCHEDULE

Completion dates of various task assignments, in accordance with contract requirements, are outlined in the schedule shown in Fig. 1-1. These dates are keyed to the RIFT Master Schedule No. 3, dated 15 Jul 1963.



**QA MANUAL PART & SECTION NUMBERS AND TITLES ARE FOR ILLUSTRATION PURPOSES ONLY.

QUALITY ASSURANCE MANUAL PART AND SECTION TITLES	
PART A – PROGRAM PLANS (PROVIDES POLICY GUIDANCE AND BASIC REQUIREMENTS AND RESPONSIBILITIES OF QUALITY ASSURANCE)	PART B – PROCEDURES
SECTION	SECTION
A-1 PROGRAM PLANNING DOCUMENTS	B-1 SUPPLIER CONTROL
A-2 ORGANIZATION AND RESPONSIBILITY STATEMENTS	B-2 INSPECTION
A-3 OUTSIDE REQUIREMENTS – OFFICIAL LMSC GENERAL MANAGEMENT DIRECTIVES	B-3 QUALITY ENGINEERING
	B-4 METROLOGY
	B-5 MATERIAL AND PROCESS CONTROL

NSP 6989

Fig. 1-1 Quality Program Plan Schedule

Section 2

QUALITY PROGRAM AND QUALITY ASSURANCE DOCUMENTATION

The Quality Program and Quality Assurance Documentation array (Fig. 2-1) shows the contractual and supporting documentation developed for compliance with Appendix B of NASA document NPC 200-2.

2.1 PRODUCT ASSURANCE MANUAL

An LMSC Product Assurance Manual, dated 16 Dec 1963, contains basic requirements for the assurance of RIFT product quality and reliability. Supplemental policies and procedures peculiar to the RIFT Program will be developed as the program progresses and will be submitted to MSFC for review prior to issue. Approved RIFT Product Assurance policies and procedures will be subsequently incorporated in a RIFT Quality Assurance Manual and will be issued over the signature of the NSP Director of Test and Product Assurance. Dates shown in Fig. 1-1 are representative of when these procedures will have been reviewed and approved or revised as necessary, by NSP Quality Assurance prior to submittal for review.

To date, two new Product Assurance procedures have been developed for use on the RIFT Program. These procedures are shown in Appendix A.

2.2 TEST AND INSPECTION PLANNING

The End-Item Test Plan and Procedures will be submitted to MSFC for approval.

2.3 DATA COLLECTION AND REPORTING

Data Collection and Reporting will be in accordance with Fig. 2-1 as developed from NPC 200-2 and supporting Reliability organizations and documents such as the NSP

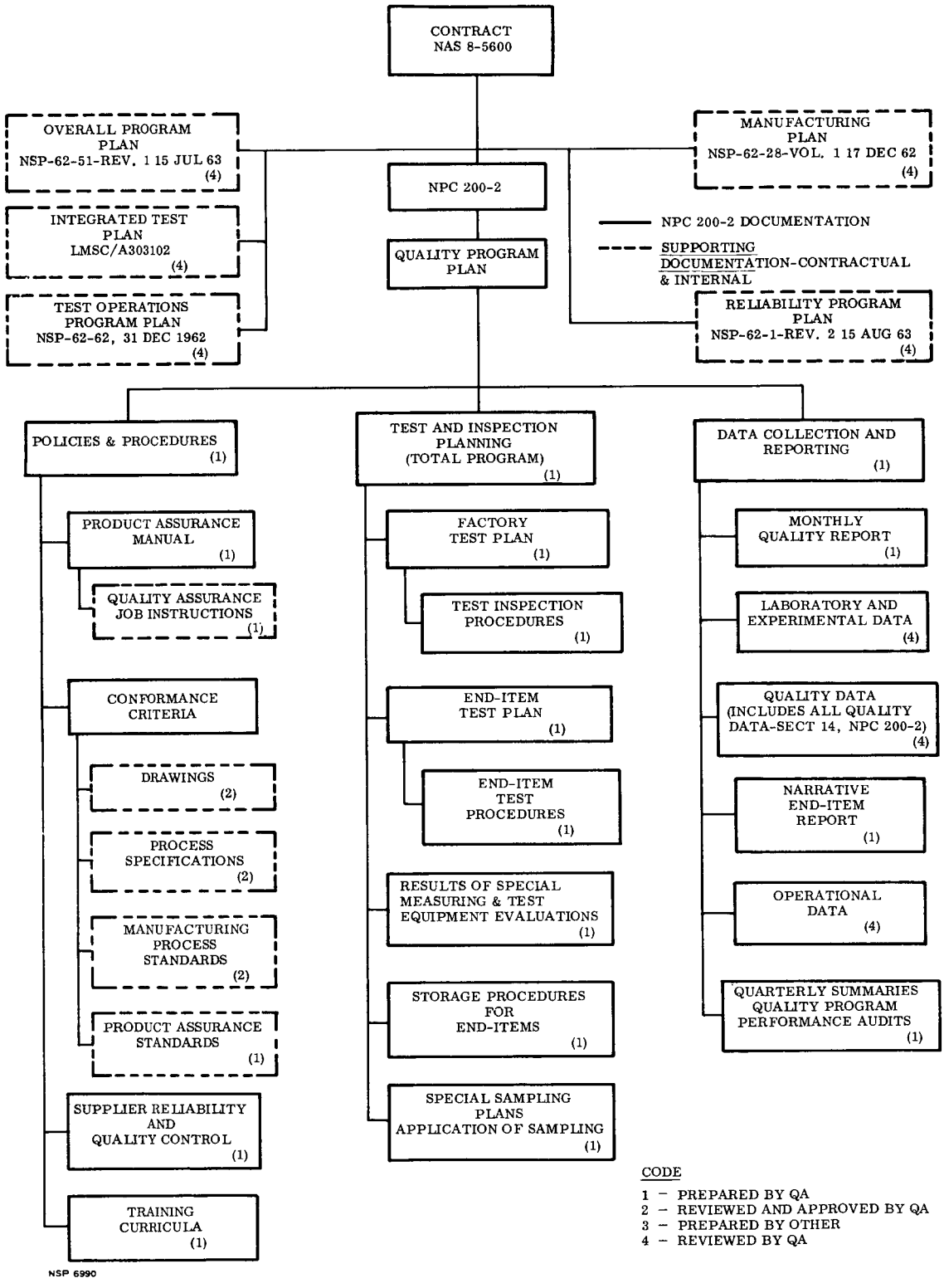


Fig. 2-1 Quality Assurance Documentation

Data Center, Candidate Preferred Parts List, Preliminary List of Approved Vendors, and the Qualification Status List.

2.4 CHANGE CONTROL

Quality Assurance will initiate and maintain rigid verification of the procedures for changes to all documents thay may directly or indirectly affect product quality and reliability. Special emphasis will be placed on interfaces with attaching stages.

The control procedures will provide for the removal of obsolete documents from operating areas and will insure that change-effectivity points are clearly indicated. End-items which require change after having been accepted will be reinspected and retested after the change has been completed. Inspection personnel will utilize the NSP Engineering Data Center to insure that inspection operations are performed in accordance with up-to-date engineering data.

Supplier-initiated changes to products being manufactured for RIFT will be carefully screened by NSP and approved prior to incorporation of the change. This action is necessary to prevent degradation of quality and reliability and to eliminate any unnecessary revisions to established and approved test procedures.

2.5 TRAINING

A development program was initiated to fabricate a nine-foot-diameter test tank for use in the training of manufacturing and engineering data personnel; the training was to be applicable to subsequent full-scale tanks. A Test and Inspection Schedule (Fig. 2-2) was established for use on this tank. Tentative inspection procedures were developed as shown in the Nine-Foot Tank Test and Inspection Plan, NSP-63-9, which was submitted to MSFC for review and comment. The results obtained by Quality Assurance from the test tank program are being evaluated for use on all tanks to be manufactured by NSP.

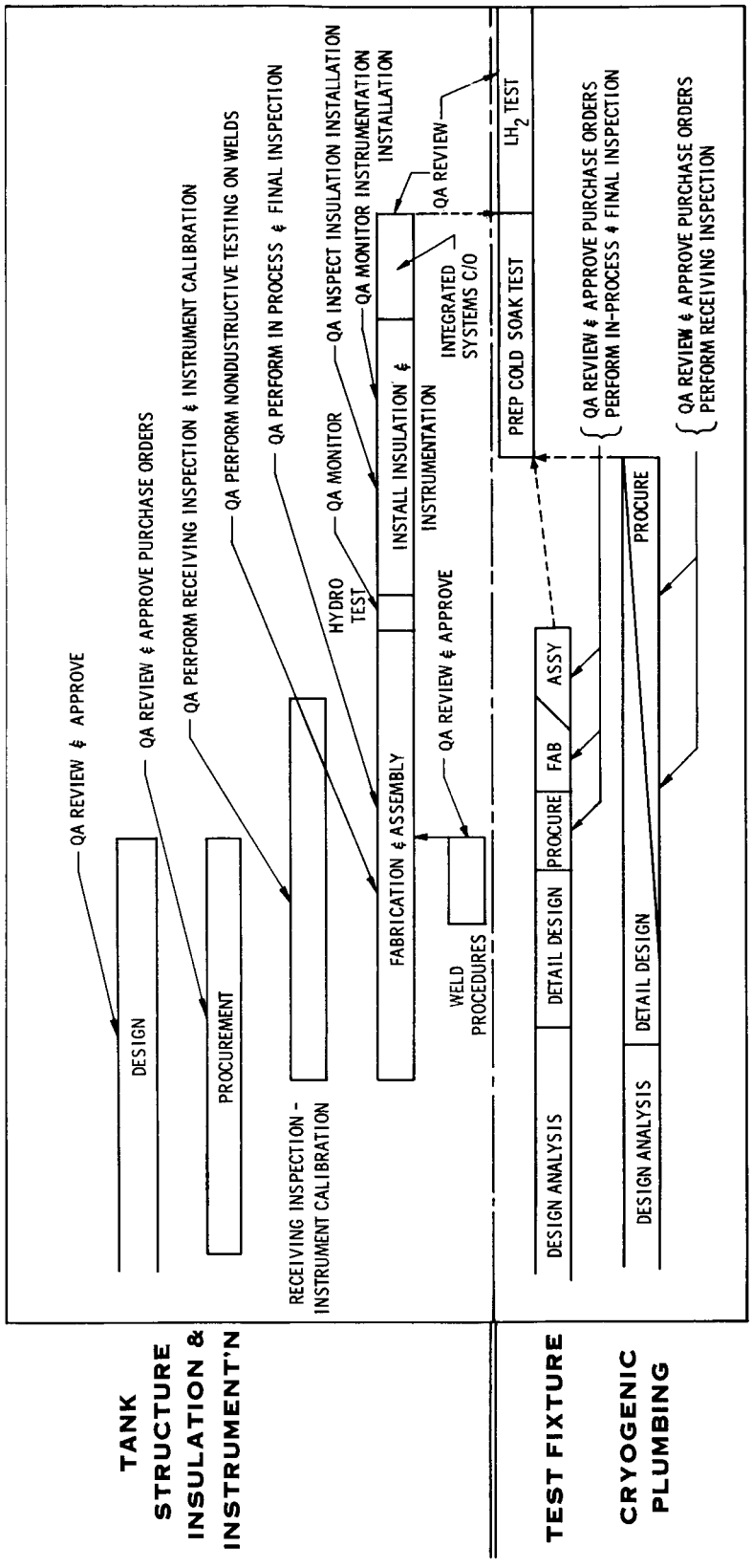


Fig. 2-2 Nine-Foot Tank Test and Inspection Schedule

Section 3
ORGANIZATION

3.1 NUCLEAR SPACE PROGRAMS AND TEST AND PRODUCT ASSURANCE

The Nuclear Space Programs (NSP), a part of the LMSC Space Programs Division (SPD), is responsible for all space programs involving nuclear propulsion. NSP is comprised of five branches (Fig. 3-1); each is under the direction of a Program Director, who reports to the Vice-President and General Manager of SPD. The NSP Test and Product Assurance Branch Directorate consists of the following operating organizations:

- Stage Test
- Development Test
- Reliability
- Quality Assurance
- Safety

All RIFT Program testing will be performed by the Test and Product Assurance Branch, per Test Operations Program Plan, NSP-62-62, dated 31 Dec 1962. The testing will include the performance of manufacturing tests by the Quality Assurance organization utilizing test procedures similar to those used by MSFC/QA.

3.2 NSP QUALITY ASSURANCE

The NSP Quality Assurance organization (Fig. 3-2) consists of five functional organizations as follows:

- Quality Planning
- Quality Engineering
- Inspection
- Test Base Quality Assurance
- Quality Assurance Test and Checkout

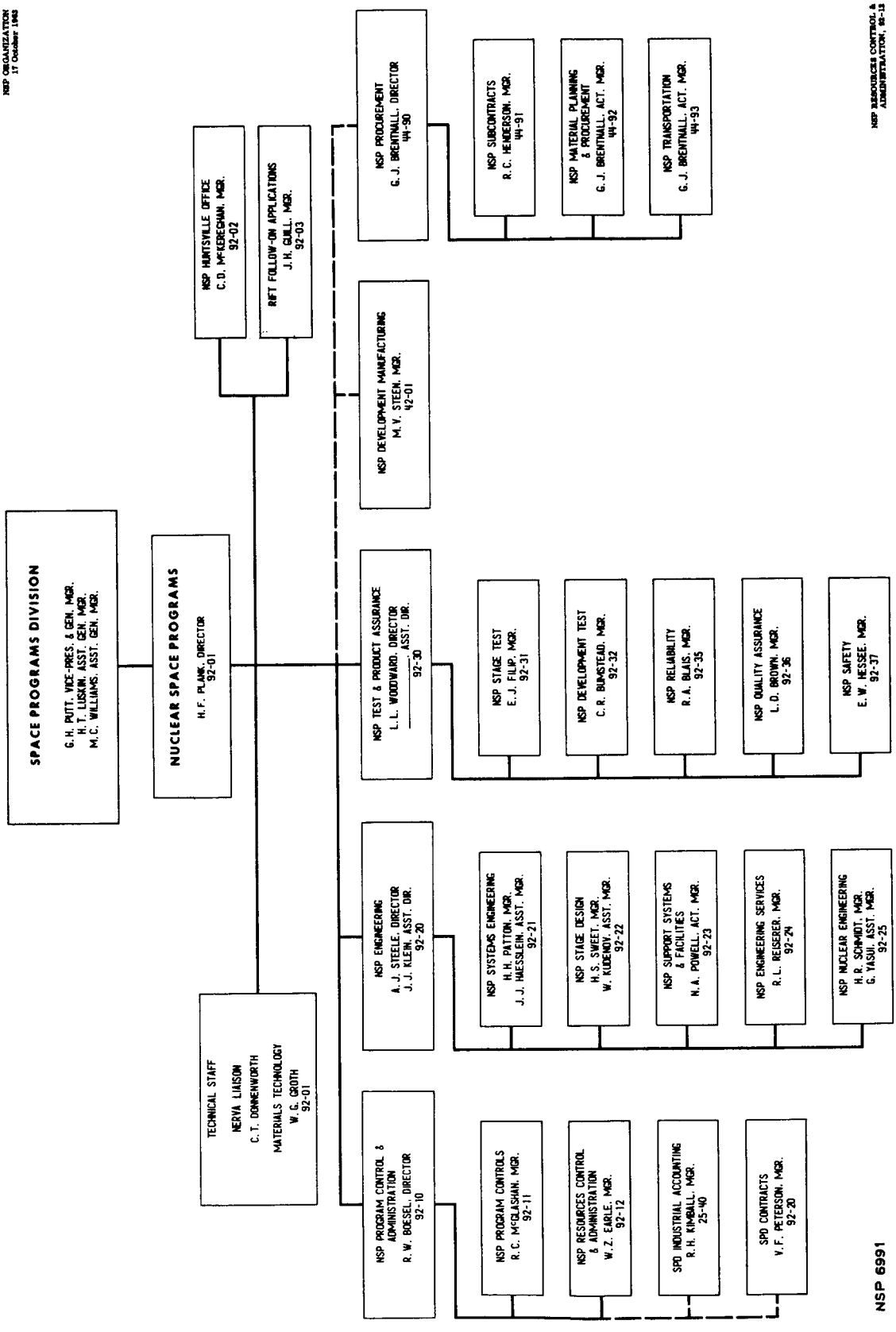


Fig. 3-1 Nuclear Space Programs (NSP) Organization

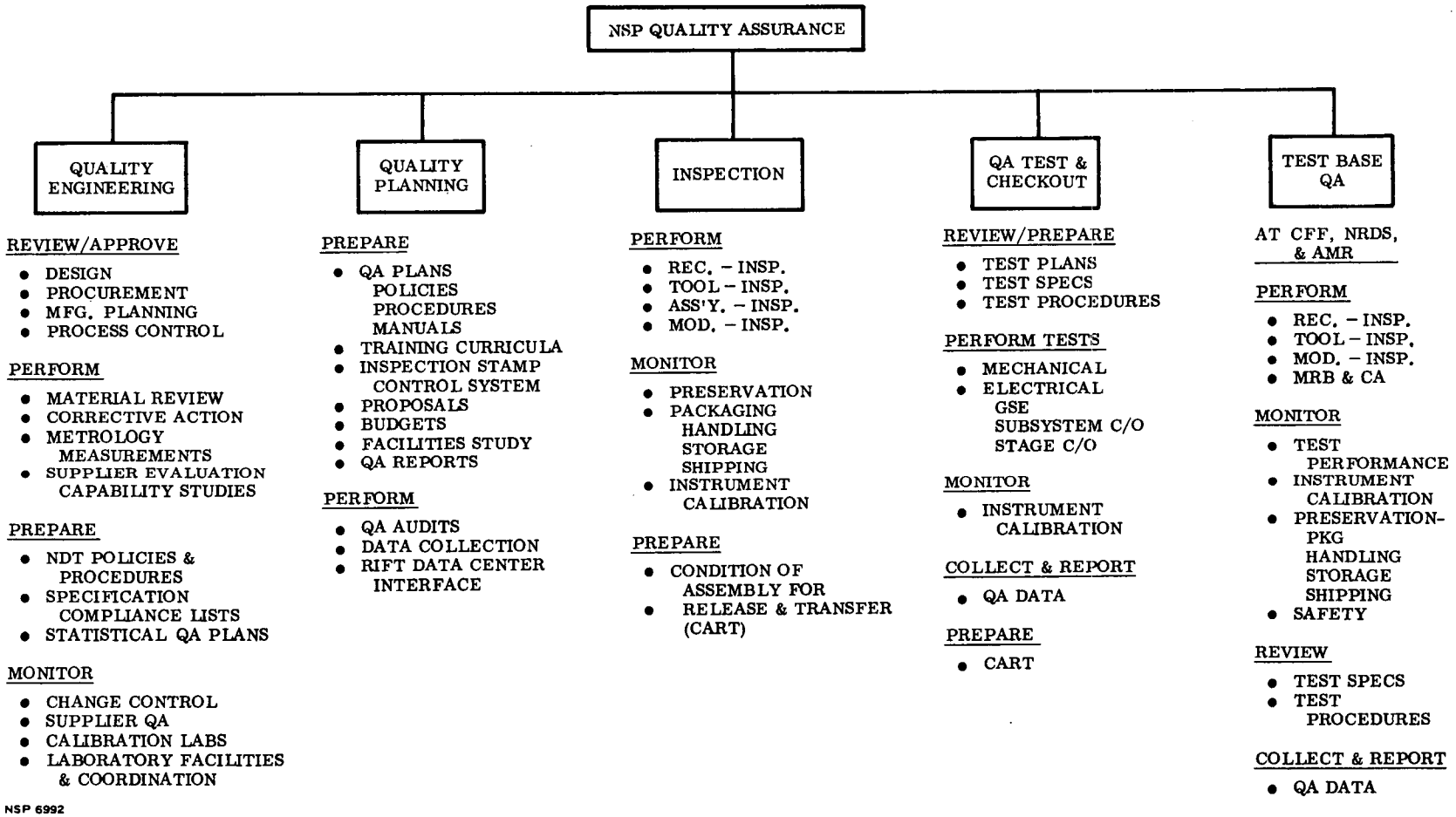


Fig. 3-2 NSP Quality Assurance Functional Organization

Quality Assurance responsibilities are also shown in Fig. 3-2 and are further detailed in other sections of this Quality Program Plan (QPP). Figure 3-3 depicts manufacturing quality assurance functional flow, with Quality Assurance organization responsibilities indicated in the solid-line boxes. A typical test base quality assurance functional flow is presented in Fig. 3-4.

3.2.1 Quality Planning Department

The Quality Planning Department has the following functions:

(1) Prepares plans, procedures, job instructions and quality standards; prepares, issues, and maintains manuals as required

(2) Prepares training curricula for use in training all personnel associated with establishing or maintaining quality and reliability requirements

(3) Establishes and maintains an inspection-stamp control system

(4) Prepares Quality Assurance reports as shown in Fig. 2-1, and performs quality audits as required by Sec. 15 of NPC 200-2

(5) Establishes interface with the NSP Engineering Data Center and the LMSC Automatic Data Acquisition (ADA) System to correlate engineering, manufacturing, and quality data

3.2.2 Quality Engineering Department

The Quality Engineering Department has the following responsibilities:

(1) Reviews and approves drawings, procurement documents, shop orders, and process control procedures for adequate quality and reliability requirements

(2) Represents Quality Assurance in design review and change control meetings

(3) Participates in nonconforming material review and disposition; coordinates corrective-action activities through design, supplier, receiving, fabrication, assembly, final checkout and test base areas to integrate malfunction analyses and to preclude the recurrence of discrepancies

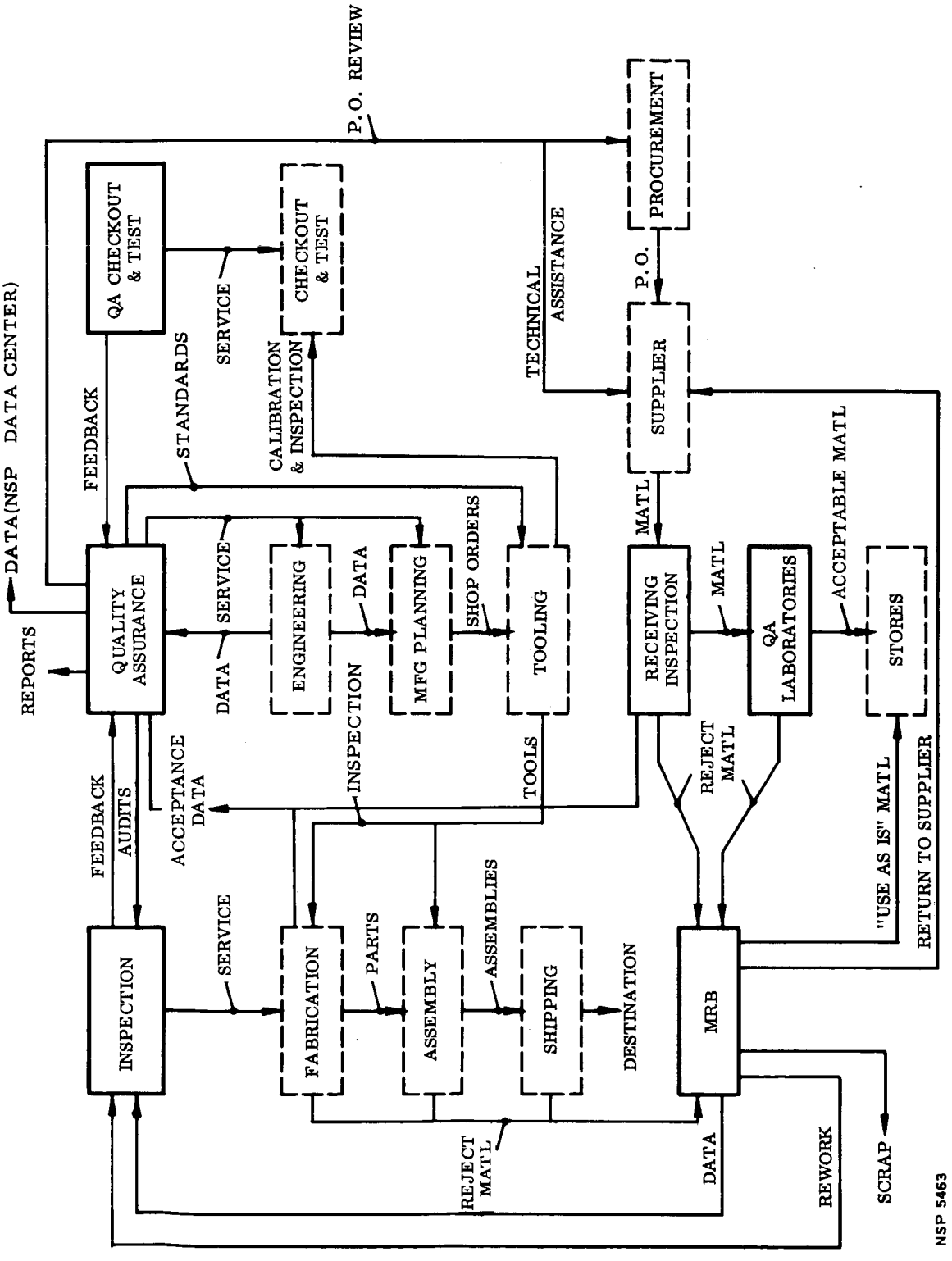


Fig. 3-3 Manufacturing Quality Assurance Functional Flow

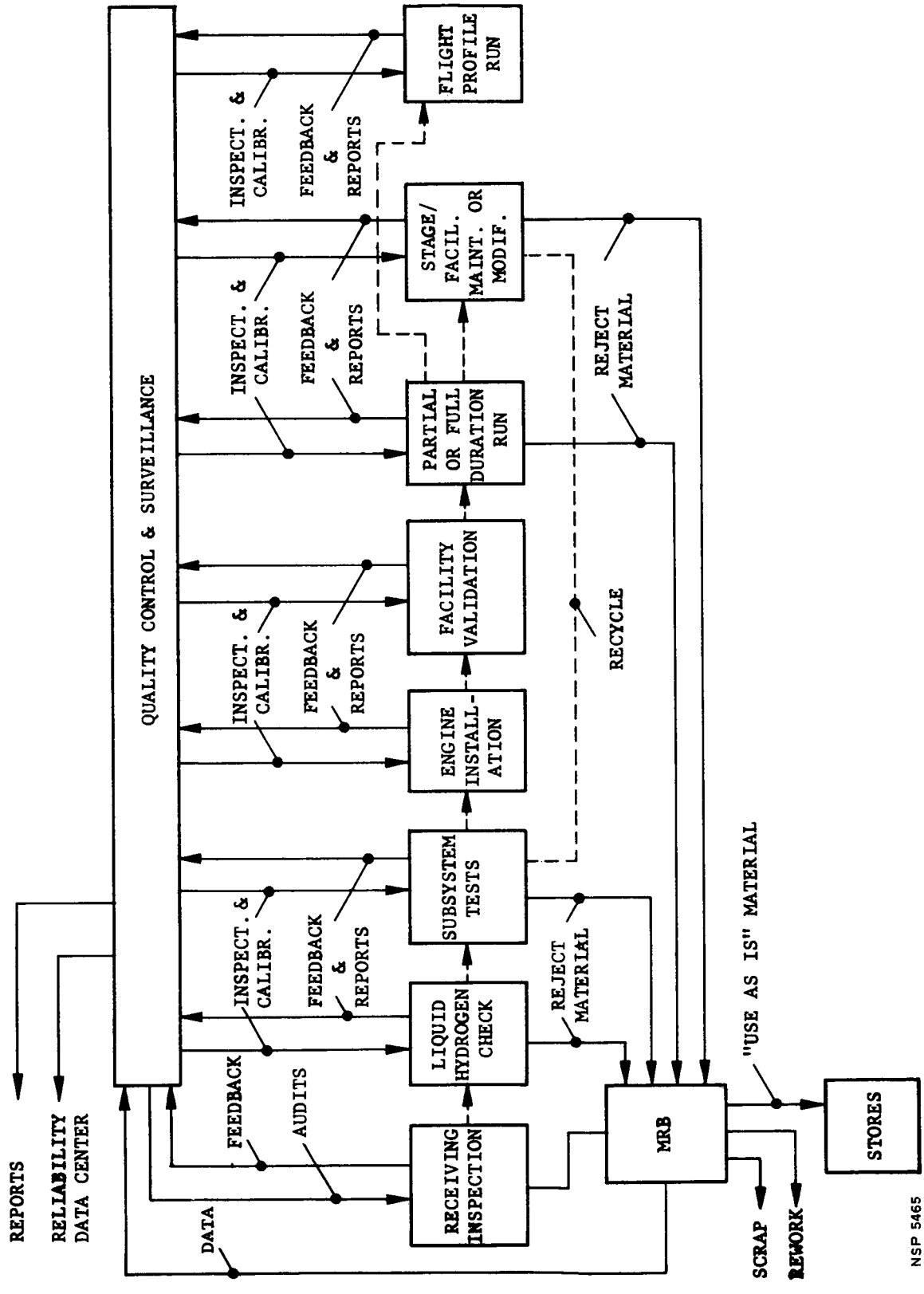


Fig. 3-4 Typical Test Base Quality Assurance Functional Flow

(4) Establishes and maintains a research and development effort seeking new and/or improved equipment, techniques, or systems for inspection and testing of nuclear-rocket stages and ground support equipment

(5) Issues and maintains a Specification Compliance Check List, which will be coordinated with the Reliability Assurance group for use in design review, failure mode and effect analyses, and reliability predictions (check list based on the detail model specifications and all applicable contractual specifications for RIFT and used by Inspection personnel to assess design and manufacturing conformance of the finished article to these specifications)

(6) Verifies, change control of all documents affecting quality or reliability and prepares documents to record the action taken

(7) In coordination with the LMSC Central Supplier Quality Assurance organization and utilizing the services of this group, conducts the following supplier-oriented requirements: performs audits/surveys, evaluates quality control systems, maintains surveillance, verifies acceptance and qualification tests, and issues inputs to the qualified supplier list (list will be coordinated with Reliability Assurance)

3.2.3 Inspection Department

The Inspection Department has the following functions:

(1) Performs inspection operations to verify that all materials, components, and assemblies comply with the design and quality requirements for acceptance including – performance of detailed electrical and electronic measurements as well as mechanical and other physical methods of measurement and conformance of configuration, encompassing compliance to contractual change requirements, as well as unit serialized changes

(2) Assures the quality of conformance from receipt of materials through shipment or acceptance of end-items by the customer

(3) In close coordination with Reliability Assurance and Quality Assurance Checkout and Test departments, provides assurance that all inspections and tests have been performed

3.2.4 Test Base Quality Assurance Department*

The Test Base Quality Assurance Department has the following responsibilities:

(1) Provides quality assurance coverage for the S-N (RIFT) stage when it leaves the manufacturing facility and procedes through the cold-flow test, complete test phase at NRDS, and launch at AMR including – surveillance of the vehicle through all phases of transportation from the time it leaves the manufacturing facility

(2) Insures compliance to the RIFT Program Safety Plan during all phases of test base operations

3.2.5 Quality Assurance Test and Checkout Department

The Quality Assurance Test and Checkout Department has the following functions:

(1) Performs checkout and fabrication tests of the S-N (RIFT) vehicle and final acceptance for delivery to NRDS or AMR – including verification and continuity checks; surveillance of weight and center of gravity tests, pressure and functional tests, instrument calibration tests, and overall systems tests; and preparation of the Condition of Acceptance and Release for Transfer (CART)

(2) Assures compatibility of the automation of checkout and test with the MSFC Automation Plan and conformity of standardization of ground support equipment and digital data-acquisition system concepts

(3) Provides assurance that all test documents and records include analyses by Quality Assurance concerning information on the final vehicle configuration, replacements made during installation, test and final checkout, nature of malfunctions encountered, corrective action taken, extent of retests, and operating time/cycle records for components and systems – including objective evidence that required material, component, system, and vehicle tests performed satisfactorily (all documents available to MSFC and MSFC representatives for review)

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*The NSP Test Base Product Assurance organization will consist of three groups – one each at Sunnyvale, NRDS, and AMR.

3.3 NSP RELIABILITY

The NSP Reliability organization , reporting to the Director of Test and Product Assurance,has the objective of establishing RIFT Program reliability requirements consistent with those of the customer and to assure their implementation through a suitable program. The Reliability organization has the following responsibilities:

(1) Provides the RIFT Program Manager with reliability programs, plans, analyses, guides, and instructions for implementing program reliability requirements

(2) Executes, or assesses the execution of, reliability programs, plans, and analyses; and make recommendations for corrective action as required

Section 4
DESIGN AND DEVELOPMENT CONTROL

4.1 DRAWING AND SPECIFICATION REVIEW

The Quality Assurance organization has assigned technically trained personnel to review and approve engineering documents for manufacturability and inspectability. This effort will assure early consideration of quality assurance and test requirements in design and planning phases and to specifically determine the following:

- Requirements for new or revised specifications as indicated by a review of designs as they are developed (LMSC/NSP Process Specifications and Manufacturing Process Standards reviewed prior to release in order to insure inclusion of quality data)
- Requirements for RIFT inspection facilities and/or tools as indicated by a review of the design during the planning stage
- Requirements for quality acceptance standards as indicated by a thorough review of all engineering documents
- Requirements for certification of equipment and personnel as indicated by a review of specifications
- Requirements for significant characteristics to be specified on inspection documents (characteristics established by a review of engineering design documents during the period of design development and prior to release)
- Significant characteristics to appear in the "characteristic" column of Fig. 5-1, and "Dim. Code" column of Fig. 7-1 (development of procedures for determination of "significant" characteristics as design and hardware evolve).

Use of qualified parts and components will be verified. Quality data relative to historical records of similar items will be reviewed for possible use.

All engineering drawings are, and will continue to be, approved by Quality and Reliability Assurance prior to release from Engineering. A typical check list for use by Quality Assurance personnel assigned to the drawing review function is illustrated in Fig. 4-1. Note that this check list is a work sheet for Quality Assurance organization internal use only and would remain on file in Quality Assurance with the applicable drawing. These check lists will be prepared as rapidly as design progress permits. In addition, these check lists will be used in part to initiate the Quality Data Record (QDR) form illustrated in Fig. 7-3 and the Supplies Check List (SCL) illustrated in Fig. 5-1.

4.2 QUALIFICATION TESTS

Qualification testing of parts, components, and assemblies will be performed by NSP to demonstrate that each design is capable of performing under the various applicable combinations of service requirements. Engineering will prepare qualification and requalification test procedures as stage design progresses, and these procedures will be submitted to MSFC for approval. Maximum use will be made of all MSFC records relative to previously qualified parts, components, and assemblies, as well as data secured from supplier qualification programs. Basically, qualification tests will be conducted in the following test categories:

- Mechanical and Physical Properties
- Combined Environmental Effects
- Nonoperating Climatic Compatibility
- Launch- and Flight-Environmental Simulation
- Shelf Life
- Limited Operating Life (LOL)

Nuclear-radiation and liquid-hydrogen environments, treated separately or in combination with vacuum, will receive special test considerations.

A list of qualified parts will be compiled as well as a qualification test status summary which will be maintained by the NSP Engineering Data Center. Before release both the list and summary will be submitted to MSFC for approval.

QUALITY ASSURANCE CHECK LIST

DWG/SPEC NO:_____ DATE:_____

DESCRIPTION:_____ MAKE/BUY_____

MATERIAL:_____ SIZE:_____

X-RAY REQD_____ CLASS_____ ZYGLO_____ MAGNAFLUX_____

ULTRASONICS_____ EDDY CURRENT_____ H. T. RANGE_____

CHECK FIXTURE REQD_____ SURFACE FINISH_____ PAINT_____

WELD REQMTS_____

CLEANING REQMTS_____

INSPECTION TOOLS_____

PRESERVATION AND PACKAGING_____

SPECIAL ASSEMBLY INFORMATION_____

TORQUEING OR DYNAMIC BALANCE REQMTS_____

MARKING AND IDENTIFICATION_____

CRITICAL DIMENSIONS	TOL. RANGE	REMARKS
A		
B		
C		
D		
E		
F		
G		
H		
I		
J		

NSP 6993

SIGNED_____

Fig. 4-1 Quality Assurance Check List

4.3 IDENTIFICATION OF PARTS AND COMPONENTS

All Lockheed-designed parts and components released by Engineering for manufacturing use will be permanently identified by a part number in conformance with the NSP drawing number system. Components procured from approved suppliers will be identified by manufacturer's part numbers and/or NSP part numbers.

Serialization of parts and components will be established to maintain historical records and for required documentation. All identification numbers will be compatible with the LMSC Automatic Data Acquisition system.

A system of serializing NSP-fabricated assemblies and certain manufacturing operations, intitled the Vehicle Segment Breakdown (VSB) method of identification, has been developed for the RIFT Program. As an example, VSB No. 4110 identifies the assembly of the nose fairing structure. Pertinent Quality Assurance operations and documents will be identified accordingly. (See RIFT Manufacturing Plan, NSP-62-28, Vol 1, dated 17 Dec 1962.)

The identification of raw material by lot and/or batch number is described in Section 5.5 of the Quality Program Plan. Identification of inprocess material is covered in Section 7.5.2.

A list of materials and parts which are impractical to serialize or identify by lot numbers after fabrication is shown in Appendix B to this document. This list is subject to approval by MSFC.

Section 5
PROCUREMENT QUALITY

5.1 SUPPLIER SELECTION

LMSC assumes the same quality responsibility for material and parts procured from suppliers as for Lockheed-fabricated parts. This basic procurement philosophy includes the following responsibilities:

- Selection of qualified suppliers and evaluation of their facilities
- Review of NSP purchase orders for the inclusion of quality and reliability requirements
- Quality evaluation of procured material by NSP Receiving Inspection
- Provision for data feedback and the prompt correction of product deficiencies
- Provision for supplying technical assistance to suppliers when a quality evaluation of their products indicates assistance is required
- Maintenance of NSP source-inspection and itinerant-inspection coverage until acceptable quality levels are attained at the supplier's facility

LMSC maintains extensive quality and reliability surveillance over the activities of a large number of suppliers. NSP will utilize, as required, the services of these existing LMSC quality organizations.

Product quality and reliability records of suppliers will be evaluated prior to placing orders for materials and components that are peculiar to the RIFT Program. In addition, facility surveys of prospective suppliers will be conducted as required.

NSP considers the efficient operation of a supplier's quality control system to be of paramount importance and will require each supplier to maintain an NSP-approved

system based upon the minimum requirements of NPC 200-3. A list of approved suppliers will be compiled and maintained from data furnished by Quality Assurance organizations in-plant and in the field and supplemented by similar data from MSFC and other MSFC contractors. This list will be prepared and issued by the NSP Engineering Data Center and submitted to MSFC for review.

5.2 PROCUREMENT DOCUMENTS

The documentation of supplier quality data will be initiated by the terms and conditions outlined on the Lockheed purchase order which constitutes a contract with the supplier. Prior to placement, the purchase order requirements will be reviewed by Quality and Reliability Assurance personnel to insure that all applicable drawings, specifications, test procedures, and peculiar inspection instructions are referenced for the supplier's use. Requirements for government and/or NSP source inspection will be established in sufficient time to be specified on purchase orders. An aggressive policy to assist suppliers toward better quality control will be followed. All procurement specifications shall be available for review by the MSFC Reliability and Quality representatives at NSP's plant.

All suppliers will be required to comply, as a minimum, with NASA Quality Publication NPC 200-3 and to invoke the requirements of this publication, and pertinent sections of NPC 200-2 as required, with their suppliers or subcontractors. A procurement specification "Supplier Reliability & Quality Control", PA-STD- 5-1.0, has been prepared by NSP Quality Assurance for the use of suppliers, and was submitted to MSFC for review and comment on 25 Apr 1963. The supplier will be required to initiate and maintain quality documentation as specified in the procurement quality specification for submission to NSP. This document is attached as Appendix C.

5.3 SOURCE INSPECTION

As noted in Sec. 5-1, NSP Quality Assurance will utilize the services of established LMSC source-inspection personnel, supplemented by additional personnel from NSP as required. Emphasis is being placed upon the supplier's responsibility to supply

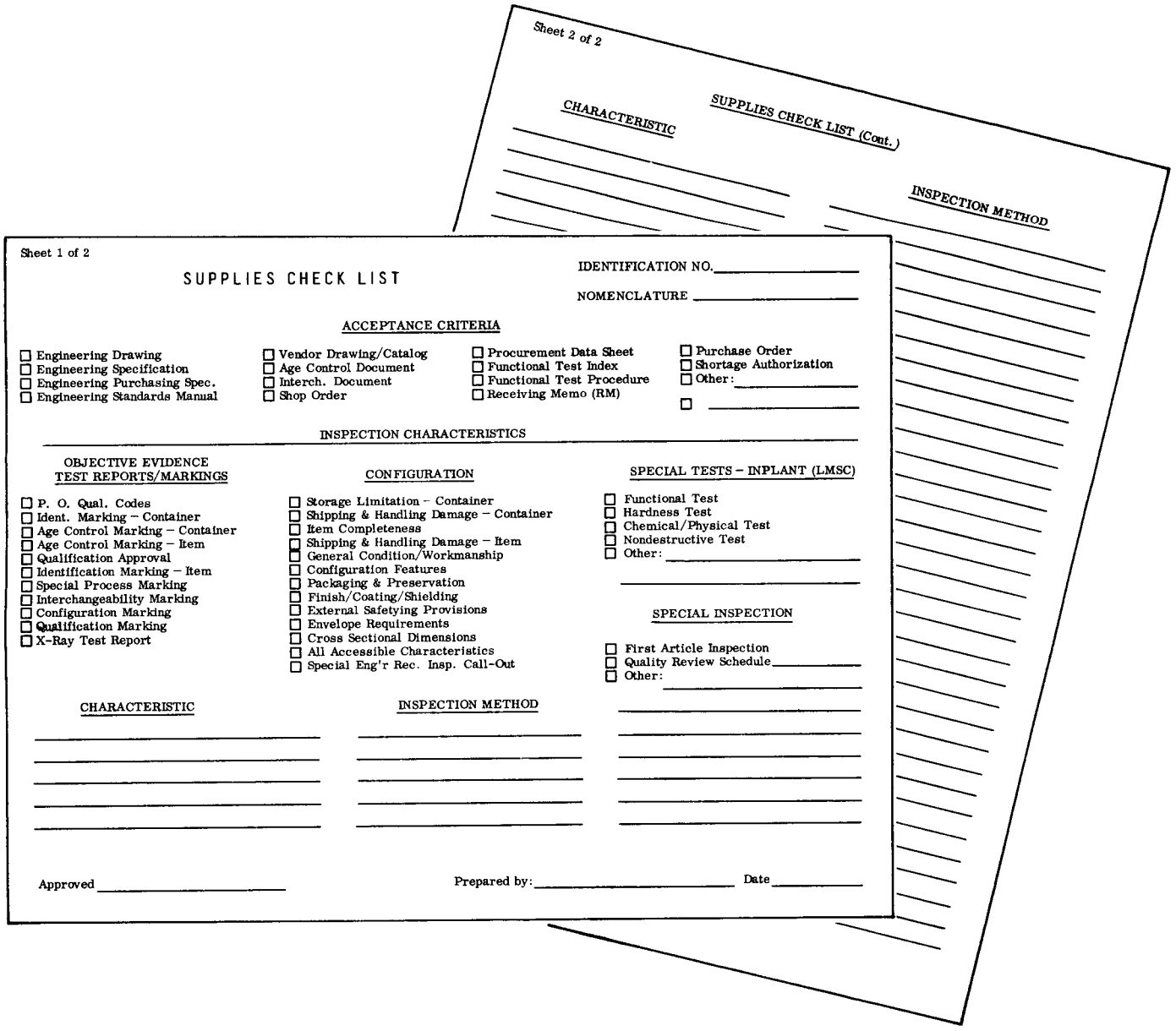
material in accordance with the terms of the purchase order. In addition, each supplier is being incouraged to utilize Lockheed experience, quality records, and assistance to the greatest possible extent. Resident source inspection, with technical assistance as required, will be maintained at a supplier's facility to insure that acceptable material is produced. Appropriate measures are being undertaken to educate new suppliers by defining quality requirements prior to beginning production and by requiring personnel training when this is determined to be necessary. Evaluation check lists will be used by Quality Assurance personnel when maintaining surveillance of suppliers on an itinerent or resident basis.

5.4 RECEIVING INSPECTION

To insure that incoming material receives maximum inspection of critical characteristics, a supplies check list (SCL) will be used to define inspection operations. This document (Fig. 5-1), prepared by the NSP Quality Assurance organization will become a permanent history record of the material involved and will remain in Receiving Inspection files.

The acceptance or rejection of incoming material will be clearly indicated on the SCL, and a segregated area will be provided for all rejected material awaiting disposition. Currently used procedures for the quality evaluation of suppliers will be followed, taking full advantage of existing records. Evidence of inspection by the supplier in accordance with NSP procurement specifications will be required. A product quality analysis will be completed to evaluate new suppliers.

Samples of incoming material will be submitted to the appropriate Quality Assurance Laboratory for analysis to verify physical and chemical properties. Material that is subject to age deterioration will be protected during storage, and adequate records will be maintained relative to critical life spans of sensitive material.



Sheet 2 of 2

SUPPLIES CHECK LIST (Cont.)

CHARACTERISTIC

INSPECTION METHOD

Sheet 1 of 2

SUPPLIES CHECK LIST

IDENTIFICATION NO. _____

NOMENCLATURE _____

ACCEPTANCE CRITERIA

- ☐ Engineering Drawing
- ☐ Engineering Specification
- ☐ Engineering Purchasing Spec.
- ☐ Engineering Standards Manual
- ☐ Vendor Drawing/Catalog
- ☐ Age Control Document
- ☐ Interch. Document
- ☐ Shop Order
- ☐ Procurement Data Sheet
- ☐ Functional Test Index
- ☐ Functional Test Procedure
- ☐ Receiving Memo (RM)
- ☐ Purchase Order
- ☐ Shortage Authorization
- ☐ Other: _____
- ☐ _____

INSPECTION CHARACTERISTICS

OBJECTIVE EVIDENCE
TEST REPORTS/MARKINGS

- ☐ P. O. Qual. Codes
- ☐ Ident. Marking – Container
- ☐ Age Control Marking – Container
- ☐ Age Control Marking – Item
- ☐ Qualification Approval
- ☐ Identification Marking – Item
- ☐ Special Process Marking
- ☐ Interchangeability Marking
- ☐ Configuration Marking
- ☐ Qualification Marking
- ☐ X-Ray Test Report

CONFIGURATION

- ☐ Storage Limitation – Container
- ☐ Shipping & Handling Damage – Container
- ☐ Item Completeness
- ☐ Shipping & Handling Damage – Item
- ☐ General Condition/Workmanship
- ☐ Configuration Features
- ☐ Packaging & Preservation
- ☐ Finish/Coating/Shielding
- ☐ External Safetying Provisions
- ☐ Envelope Requirements
- ☐ Cross Sectional Dimensions
- ☐ All Accessible Characteristics
- ☐ Special Eng'r Rec. Insp. Call-Out

SPECIAL TESTS – INPLANT (LMSC)

- ☐ Functional Test
- ☐ Hardness Test
- ☐ Chemical/Physical Test
- ☐ Nondestructive Test
- ☐ Other: _____

SPECIAL INSPECTION

- ☐ First Article Inspection
- ☐ Quality Review Schedule _____
- ☐ Other: _____

CHARACTERISTIC

INSPECTION METHOD

Approved _____

Prepared by: _____ Date _____

NSP 6994

Fig. 5-1 Supplies Check List

5.5 IDENTIFICATION OF PRODUCTION MATERIAL

Immediately upon receipt of RIFT production material, a process control number (PCN), traceable to the supplier lot, heat treat, or batch number, will be assigned to provide positive identification throughout the manufacturing cycle. Samples of material that have been used for properties verification will be identified with a PCN to provide cross identification with the supplier's heat treat, batch, or lot number. Parts manufactured from PCN-identified material reference the parent material for historical record purposes. Serialization of supplier-manufactured components will be maintained and used for part identification through all phases of assembly and test.

Parts heat treated during manufacturing will have an identification reference to the applicable furnace log as well as to the tensile coupons that verify the required physical characteristics. Coupons will be supplied to the MSFC Quality Assurance Laboratory as required.

5.6 QUALITY DATA FEEDBACK

The NSP Engineering Data Center will collect inspection data and issue periodic quality reports to interested organizations. Data obtained from Receiving Inspection reports and test results will be analyzed and the information transmitted to affected suppliers. This information will be designed to prevent recurrence of discrepancies and for follow-up of corrective action at the supplier's facility when the need for such action is indicated. Data from source inspectors, field failure reports, and manufacturing records will be evaluated and summarized by the NSP Engineering Data Center for distribution to suppliers at periodic intervals. Distribution of quality reports will be initially accomplished by manual analysis of data until the RIFT Program progresses to a point where automatic means can be utilized.

NSP will expand the existing procedures that govern the accuracy of inspection and test equipment to provide correlation of inspection and test procedures between LMSC/NSP and suppliers. Quality data feedback will be used to facilitate coordination of NSP supplier effort in this field.

Section 6
GOVERNMENT FURNISHED PROPERTY (GFP)

6.1 RECEIPT OF PROPERTY

Immediately upon receipt of all incoming shipments of GFP, the LMSC/NSP Receiving Inspection organization will inspect the shipment for transportation damage and conformity to pertinent documentation requirements. The MSFC Quality Assurance representative will be notified prior to performing this inspection in order to facilitate coordinated accumulation of GFP quality data.

6.2 TESTING AND PROCESSING CONTROLS OF COMPONENTS

Functional testing of GFP components will be performed in accordance with procedures that have been approved by MSFC. Procedures will be initiated by Quality Assurance to assure adequate controls for the safeguard of GFP quality during handling, transportation, storage, and installation.

6.3 DAMAGED PROPERTY

In the event that GFP is received in a damaged condition, or is subsequently discovered to be unsuitable for its intended use, NSP will immediately notify the cognizant NASA installation through established channels of communication. Discrepant material will be submitted to the local MSFC representative for verification of condition and disposition.

Section 7

MANUFACTURING QUALITY ASSURANCE

7.1 GENERAL DESCRIPTION

The NSP program for quality control of fabrication, processing, and assembly manufacturing operations will start early in the engineering design phase. A Design Release Control Board (DRCB) has been established with participation by Engineering Stage Design, Engineering System Design, Procurement, Manufacturing, and Quality and Reliability Assurance. At the committee meetings, the DRCB engineering representative will describe design concepts which will be followed by discussions of the tooling plan, manufacturing sequence plan, and quality assurance requirements to result in the establishment of an engineering design package.

This design package will be used to prepare an engineering drawing release schedule based upon manufacturing requirements for material, tooling, or special processing equipment; and this schedule will be correlated with manufacturing plans for fabrication and assembly of the first article. Manufacturing will utilize a Vehicle Segment Breakdown (VSB) to establish control of each vehicle segment. Requirements for material, components, facilities, tooling, personnel training and certification, manufacturing operations, and Product Assurance Standards (PA-STD) will be established for each VSB manufacturing unit.

7.2 CONFORMANCE CRITERIA

Criteria for determining conformance of produced articles to contract requirements shall consist of, but not be limited to, the following customer and contractor documents as applicable:

- NASA Contract NAS 8-5600
- Specification and Specification Deviation Document, NSP-63-1-Rev. 1

- Quality Program Plan, NSP-63-2-Rev. 1 (this document)
- RIFT Reliability Program Plan, NSP-62-1-Rev. 2, dated 15 Aug 1963
- RIFT Product Assurance Manual
- RIFT Engineering Process Specifications
- RIFT Engineering Purchasing Specifications
- RIFT Materials and Parts Manual
- LMSC Parts and Components Manual,Vol. IA, IB, II
- LMSC Manufacturing Process Standards
- LMSC Product Assurance Standards
- RIFT Inspection and Test Plan
- RIFT End-Item Test Plan

7.3 INSPECTION AND TEST PLANNING

Quality Assurance representation of the DRCB will provide for inspection and test planning during engineering design of the RIFT vehicle. This use of design packages and VSB's will provide for comprehensive review of the fabrication, processing, and assembly operations; the manufactured articles; and the methods for final assembly and checkout. NSP inspections and tests will encompass all fabrication and assembly operations and will be guided by use of the shop order form, test procedures, or log book which list the operations to be performed and the sequence to be followed.

The manufacturing planning documents will be reviewed by quality engineers assigned to the Manufacturing organization for stipulating inspection audit points and determining peculiar inspection requirements and techniques. Each inspection operation performed will be "stamped" on the shop order by the inspector who performs the inspection.

7.3.1 Inspection and Test Plans

Inspection and test plans, prepared by the Quality Assurance organization, will be separately compiled and maintained documents and will contain the following:

- A "test schematic" depicting the RIFT Stage System and the related components involved in each system to be tested
- A technical description of the subassembly, or assembly to be tested
- Parameters and characteristics to be inspected and/or tested
- Nominal and tolerance values of these parameters
- The test sequence to be followed, and the test conditions to be applied with complete documentation of test results, which will be submitted to MSFC for approval

7.3.1.1 RIFT Factory Test Plan. Under Contract NAS 8-5600, the RIFT Program organization (NSP) has the responsibility to manufacture the RIFT stage. This responsibility includes manufacturing a stage system that is of acceptable quality under NASA specifications, requirements, and requests. The primary purpose of the RIFT Factory Test Plan will be to outline the quality assurance requirements and the subsequent steps required during factory operations to verify the acceptable level of quality required by the customer. These operations will encompass all controls, tests, checkout, and surveillance on all materials, parts, components, subsystems, and subassemblies which will make up the total RIFT final assembly, commencing at receiving inspection and terminating at system checkout. The RIFT Factory Test Plan will consist of the following specific activities:

- Receiving Inspection
- Receiving Test
- Receiving Functional Test
- Nondestructive Test
- Inprocess Inspection
- Alignment Check
- Tool and Gage Calibration
- Subassembly Checkout

- Manufacturing Checkout
- Assembly Checkout

The Factory Test Plan specific objectives will be as follows:

(1) To establish the factory quality assurance test and inspection requirements for all materials, components, assemblies and manufactured articles for the RIFT Program
(2) To establish the relationship of the quality assurance requirements in the overall program plan
(3) To establish the Factory Test operational sequence
(4) To establish the preliminary facility and equipment needs to accomplish the above objectives

7.3.1.2 End-Item Test and Inspection Plan. The End-Item Test and Inspection Plan is presently envisaged to satisfy those requirements specified in NASA Quality Publication NPC 200-2, Sec. 7, paragraphs 7.3 and 7.4, and in the Quality Program Plan, NSP-63-2. The tests and inspections, to be specified in this End-Item Test and Inspection Plan, will be complementary to, and an expansion of, those tests delineated in the Integrated Test Plan, NSP-62-05, and the Factory Test and Inspection Plan. These tests and inspections, included in this plan, will be performed in the factory by Quality Assurance personnel during the logical sequence of receiving, manufacture, final acceptance, and transfer of the RIFT/S-N stage, GSE, and spares to the user and during the receiving, preparation, and use of these items at the respective field test locations.

The purpose of this plan is to demonstrate the method by which the contractor, LMSC/NSP, will ensure quality and reliability of the end-item to the using agency, MSFC. (End items are defined as those individual, deliverable items of GSE, STE, GFP, the complete stage/less engine, and required spares.) The development point selected for end-items will begin when the item has progressed beyond the subassembly level of development. Test and inspection audit points will be carefully selected, in the assembly cycle after part fabrication but prior to system close up, as ideal from the

overall inspection sense. System verification, conformity to contract requirements, and design intent are the objectives for performance of these inspections and tests. Tests and inspections below this level are covered in the Factory Test and Inspection Plan.

7.3.2 Factory Inspection and Test Procedures

Functional responsibilities for operation of the Factory Inspection and Test Plan are allocated as follows:

(1) NSP Engineering will initiate and issue test requirement specifications, and Test and Product Assurance will review and approve test specifications.
(2) Test and Product Assurance will prepare and issue the test procedures, after approval by NSP Quality Assurance and Engineering.
(3) Each characteristic to be observed will be defined in terms of:
    a. The conditions that should exist at each examination point
    b. The tolerance conditions under which the characteristic being examined may be considered acceptable
    c. The levels or limits of inputs and stresses (In the case of visual inspections, the optimum acceptable conditions shall be defined.)
(4) Test and Product Assurance will establish test equipment requirements subject to approval of design concept by NSP Engineering and Quality Assurance.
(5) Test and Product Assurance organizations will perform tests and document the test results in accordance with test procedures.
(6) A "first-run" committee composed of Engineering, Quality Assurance, Reliability, Manufacturing, and Test Operations, as applicable, will witness the first article or system to be tested to prove the workability of test procedures.

Upon completion of a "first-run", inspection and test procedures will be submitted to MSFC for review prior to implementation.

7.3.3 MSFC Review

Product Assurance Standards (PA-STD) currently used on LMSC existing contracts have been submitted to MSFC for review. Additional RIFT PA-STDS will be prepared as the vehicle design progresses and will be submitted for review. Sample parts will be utilized to illustrate the quality levels of workmanship that are required to manufacture the RIFT vehicle. These sample parts will be maintained in an up-to-date configuration and replaced as required by design improvements.

7.4 INSPECTION AND TEST PERFORMANCE

The performance of factory test operations will be accomplished under conditions that simulate end-item use. These operations will be accomplished to the degree practicable for providing a satisfactory measure of overall quality. Test personnel will be technically trained for specific responsibilities and will be certified as required for special test functions. Documentation of test results will be maintained and submitted to MSFC as required.

Personnel and equipment required to comply with nondestructive test requirements will be certified in accordance with all applicable specifications, and certified personnel will be properly identified.

Destructive and nondestructive tests will be performed by Quality Assurance personnel as required. Certain selected supplier-furnished components will be completely disassembled for evaluation at periodic intervals in accordance with approved procedures.

7.4.1 Critical Characteristics Control

The control of inprocess material and parts will be facilitated by the use of a form such as the Quality Data Record (QDR), illustrated in Fig. 7-1. This form when complete will become an historical record of inspection operations which will accompany the part and shop order throughout the manufacturing cycle, and will be returned to

QUALITY DATA RECORD

SHEET____ OF ____

PART NO.	DESCRIPTION:	REVISION	EO	SERIAL NO.

		TENSILE		YIELD		PERCENT ELONG.		HARDNESS	
		SPEC	ACTUAL	SPEC	ACTUAL	SPEC	ACTUAL	SPEC	ACTUAL
RAW MATL	MAX								
	MIN								
FINISHED PART	MAX								
	MIN								

HEAT TREAT SPEC	X-RAY CLASS/SPEC	DYE PENETRANT	WELDING SPEC	FINISH SPEC	SIGNATURE, DATE	CONTROL NO.

DIM. CODE	BASIC DIMENSION	TOLERANCE	ACTUAL DIM.	REMARKS	DIM. CODE	BASIC DIMENSION	TOLERANCE	ACTUAL DIM.	REMARKS
		+ −					+ −		
		+ −					+ −		
		+ −					+ −		
		+ −					+ −		
		+ −					+ −		
		+ −					+ −		
		+ −					+ −		
		+ −					+ −		
		+ −					REJECTION HISTORY		
		+ −							
		+ −							
		+ −							
		+ −							
		+ −							
		+ −							

NSP 5473

Fig. 7-1 Quality Data Record

LOCKHEED MISSILES & SPACE COMPANY

Quality Assurance. The QDR will be approved by Inspection supervision when complete and will be available to MSFC as required. The pictorial presentation method of illustrating the part to be inspected will be used when practical and economical.

7.4.2 Final Assembly and Checkout

A Checkout Coordination Committee (CCC) has been established by NSP to include representatives from Systems Engineering, Stage Design, Test Operations, Manufacturing, and Quality and Reliability Assurance. The current functions of the CCC are to establish automatic checkout requirements of the RIFT vehicles compatible with MSFC Automation Plan, dated 8 May 1962. RIFT checkout will be performed at the Propellant Tank Facility (PTF), Cold-Flow Facility (CFF),Nuclear Rocket Development Station (NRDS), and Atlantic Missile Range (AMR). Automatic and manual checkout facilities, equipment, and procedures will be standardized as far as is practical for all locations.

Equipment requirements and design responsibility will be jointly determined by NSP and NASA.

7.5 FABRICATION CONTROLS

7.5.1 Tool Inspection

The inspection of production tools is a responsibility of the NSP Quality Assurance organization which will assure that the tools conform to tool design specifications. A "tool-try" procedure, based on acceptance of the first part or first assembly produced by the tooling involved, will be used to accept material for production and to insure tool conformance to vehicle design specifications.

Production tools, master gages, and interface tools, that are used as media of inspection because of size and/or complexity, will be reinspected at periodic intervals after initial approval to insure continued accuracy. Historical records will be maintained

of all tool inspection operations in a manner to be readily available at all times; tool change records will be maintained on the same form.

7.5.2 Material Control

As described in Sec. 5.5 of this document, a control number (PCN) is assigned to incoming material for identification purposes. This PCN must be stamped or printed on the shop paperwork that is presented to stores for withdrawing material; an inspector will verify that this PCN is the same as that indicated on the material being withdrawn. Only material which has been approved by Quality Assurance will be stocked in stores. Continual monitoring by inspection personnel will insure that the correct material is mated with the appropriate shop paperwork during fabrication operations. Reports, engineering orders, and changes will also be identified with material and paperwork, as will all approved rework resulting from Material Review Board (MRB) action.

Materials and articles subject to quality and reliability degradation, due to age and/or use, will be suitably controlled.

7.5.3 Cleanliness Control

The cleanliness of parts and assemblies is the subject of special procedures by all Quality Assurance organizations. Cleanliness of working areas and equipment will receive close attention at all times, and full advantage will be taken of all available knowledge on the subject, regardless of source. The specifications for clean room facilities, clothing to be worn by personnel, tools to be used, and packaging techniques for cleaned material will be approved by Quality Assurance.

7.5.4 Process Control

Lockheed Process Specifications are being used as control media for factory manufacturing operations and for establishing the requirements for Manufacturing Process

Standards (MPS). The latter will be used by the factory to facilitate the actual performance of operations, and a program of defect prevention for special processes is currently in effect.

Quality and Reliability Assurance personnel are reviewing all process specifications and MPS's prior to issue and will conduct periodic audits to verify that actual operations conform with approved methods and procedures. Records are being maintained of all equipment certification tests as well as the proficiency, capability, and adequacy of personnel responsible for certification, subject to MSFC disapproval.

The authorization for use of LMSC nondestructive test facilities and the procedures for their use are responsibilities of NSP Quality Assurance and include the following:

- Radiographic Inspection
- Ultrasonic Inspection
- Magnetic-Particle Inspection
- Liquid-Penetrant Inspection

Section 8
NONCONFORMING MATERIAL

8.1 MATERIAL REVIEW BOARD

Control, review, and disposition of nonconforming material are the responsibilities of a Material Review Board (MRB) operating under the authority of the Quality Assurance organization. The MRB shall determine the disposition of minor nonconforming material and recommend the disposition of major nonconforming material. This board consists of the following personnel:

- Director of NSP Test and Product Assurance
- Director of NSP Engineering
- RIFT Resident Project Manager

Additional MRB's,staffed by deputies, shall be established as required by volume and diversity of operations. Competent deputies and alternates for all required boards shall be appointed and approved by the MRB. However, under no circumstances will the authority for the final review and disposition of material be delegated to a subcontractor or supplier.

Other organizations or personnel may be consulted by the MRB to assist in determining optimum dispositions for nonconforming items. Information thus obtained shall be used at the discretion of the board.

8.2 STORAGE OF NONCONFORMING MATERIAL

A restricted and enclosed area will be provided for the temporary retention of all nonconforming material which has been removed from production channels. When the physical characteristics of the nonconforming article prevents its movement to

an enclosed area, the article will be suitably identified, and the MRB will review the nonconformance at the article's location.

8.3 DISPOSITION OF NONCONFORMING MATERIAL

Acceptance of nonconforming material in the "use-as-is" condition will be determined by unanimous agreement of the board members. A decision to rework defective articles to specifications, or to repair, will be made in accordance with established RIFT Program procedures that define the nature of the defect.

Defective material, which has been reviewed and dispositioned by MRB action, will be suitably identified, in the event that subsequent evaluation is necessary at later inspection, assembly, and test points for the effect on higher levels of assembly.

Certain types of rework will not require formal MRB review; such rework will be clearly defined in procedures that will have been submitted to MSFC for approval prior to issue.

Definitions applicable to this effort are as follows:

- Nonconformance is defined as any departure of a product from specified requirements or design intent.
- Major Nonconformance is defined as any nonconformance that could result in hazardous or unsafe conditions for individuals using or maintaining the affected products; or could adversely affect reliability, durability, performance, interchangeability, weight, or the basic design intent.
- Minor Nonconformance is defined as any nonconformance, other than major, that does not materially reduce the usability of the product for its intended purpose; or is a departure from established standards having no significant bearing on the effective use or operation of the product or associated units.

8.4 MALFUNCTION ANALYSIS AND CORRECTIVE ACTION

The activities and actions of all NSP organizations concerned with discrepant material, malfunction analysis, material review, and corrective action will be in accordance with NSP-PA Procedure No. 4 and the "Malfunction Analysis and Corrective Action Flow Chart," PA No. 100.

Section 9

INSPECTION, MEASUREMENT, AND TEST EQUIPMENT

9.1 CALIBRATION

All production tools and automated equipment that have an inspection, measurement, and test function will be periodically calibrated on a scheduled basis to standards traceable to the United States Bureau of Standards. Records will be maintained to reflect the date of the last calibration and the date of the next due calibration, and a label bearing this information will be prominently displayed on each item subject to calibration. LMSC operates and maintains calibration facilities which will be used to the maximum extent possible to support the RIFT Program. The manufacturing facility will include measurement standards equipment that will be under the jurisdiction of NSP Quality Assurance and maintained by established LMSC Measurement Control laboratories.

Within state-of-the-art limitations, the standards used for calibration of inspection, measurement, and test equipment shall have a tolerance no greater than 10 percent of the allowable tolerance for the equipment being calibrated.

9.2 EVALUATION

The NSP Quality Assurance organization is responsible for inspection and evaluation of all inspection, measurement, and test equipment prior to initial use, thus determining the equipment accuracy and tolerance values that must be known; the evaluation results on special equipment will be documented and submitted to MSFC for review.

9.3 MAINTENANCE

All inspection, measurement, and test equipment will be periodically inspected and recalibrated, as necessary. Present LMSC policies and procedures are followed to remove from service any equipment that has not been maintained or calibrated on schedule. Out-of-service equipment is identified by the use of suitable tags or labels prominently affixed to the equipment; a return-to-service status will be accomplished by recalibration.

9.4 PROCEDURES AND RECORDS

All existing LMSC procedures designed to govern calibration, operational check, evaluation, and maintenance are being reviewed for applicability to the RIFT Program. New procedures will be written as necessary, and all procedures will be submitted to MSFC for review. Complete calibration status records will be maintained that will reflect an up-to-date history of each item of equipment. In addition, these equipment history records will reflect variables data and will be used for analyses to determine equipment wear, deterioration, and maintenance control.

Section 10
INSPECTION STAMP CONTROL

10.1 STAMP CONTROL

The existing LMSC stamp-control procedure will be reviewed for applicability to the RIFT Program when the manufacturing plan has been sufficiently developed to determine requirements. The procedure to be used will provide the following features:

- Stamps, rubber and steel, will be assigned only to qualified inspection personnel, and records will reflect the individual's identity by name, clock number, and work station.
- Instructions will be issued for the proper use of stamps and forms.
- Only the proper stamps will be applied to nonconforming material.
- Emphasis will be on the importance of safeguarding stamps.

Production workers from the manufacturing organizations are being assigned stamps of distinctive design to identify completed manufacturing operations on shop documents. Control of these stamps will be a responsibility of Quality Assurance. The withdrawal of production stamps for unsatisfactory workmanship reasons will be a prerogative of either Quality Assurance or Manufacturing supervision.

10.2 LABELS, TAGS, AND DECALS

Labels, tags, and decals to be used on RIFT material will be selected as required from the designs in current use by LMSC. Where it is important to emphasize RIFT material identity, new designs will be created.

Section 11
PACKAGING, STORING, HANDLING, AND SHIPPING

11.1 PACKAGING

LMSC has developed advanced techniques for packaging parts that are sensitive to deterioration and damage caused by careless handling. Pertinent procedures are being reviewed to determine suitability for the RIFT Program. The procedures to be used will incorporate the following features:

- All articles subject to damage in the packaged state will be specifically considered for application of special packaging methods.
- Requirements for packaging will include the use of proper preservation techniques and cleanliness of the article prior to preparation for packaging.
- Packaging methods will include means of indicating critical environment within the package such as moisture content, temperatures, and gas pressure.
- Maintenance will be provided for any special environment control equipment, with control procedure on the exteriors of containers.
- Hi-Rel packaging methods and procedures will be used. (See NASA Preferred Parts Handbook – Definitions.)

11.2 STORING

All articles that must be stored for any period of time will be adequately protected against damage and deterioration while in storage. Existing LMSC procedures will be reviewed to determine application to the RIFT Program. New procedures will be written as necessary to insure adequacy of maintenance and safety measures, and periodic inspection schedules of stored material will be initiated and maintained.

Special procedures will be written to cover the temporary storage of end-items. These procedures will be submitted to MSFC for review prior to their introduction for use. Temporary storage is interpreted as an unanticipated requirement for storage of articles sensitive to storage conditions, or for which no proper storage facilities were planned or provided.

11.3 HANDLING

Development of special handling equipment to protect large RIFT components during the manufacturing cycle is recognized as an important phase of quality control. The design and manufacture of this equipment will be subject to review by Quality Assurance, and procedures will be initiated to provide instructions for proper handling of components.

All installation and test sites will be provided copies of special handling instructions to ensure safe and adequate handling.

11.4 SHIPPING

Existing LMSC shipping procedures will be closely examined to determine their applicability to the RIFT Program. Any shipping procedure that will be applied to RIFT material will incorporate the following features:

- Inspection to insure that all articles have been inspected and tested in accordance with applicable specifications prior to packaging
- Segregation of accepted items from those still to be inspected or tested
- Inspection to be sure that all articles are complete as planned
- Inspection for correct preservation and packaging in accordance with procedures and specifications
- Inspection for proper identification and marking

- Inspection to insure that all required documentation is complete and that the necessary paperwork is included in the shipment
- Provision for vehicles being transported from the manufacturing facility to next destination to be accompanied by Quality Assurance personnel.

Section 12
STATISTICAL QUALITY CONTROL

12.1 METHODS

Inasmuch as the initial phases of the RIFT Program constitute a research and development effort, extensive use of conventional statistical quality control methods is not anticipated. However, extensive use will be required of quality control procedures designed to emphasize complete inspection and defect-prevention techniques, with attention being specifically directed to the introduction and maintenance of programs for the purpose of minimizing human errors.

Statistical quality control methods will be programmed by Quality Assurance whenever these methods will be of value in maintaining required quality levels. Charts, when used, will indicate the "out-of-control" status of a problem area; Quality Assurance will maintain the charts as an action and defect-prevention tool.

12.2 SAMPLING PLANS

The use of sampling plans will be confined to the inspection of miscellaneous small parts (MSP) and to destructive inspections and tests. Prior to use, all sampling plans considered suitable for the RIFT Program will be reviewed by MSFC. An analysis of an article's end-use will determine whether a sampling plan will be considered and the extent to which it will be applied.

Miscellaneous small parts are generally defined as fasteners, packing rings, washers, grommets, etc. See items (all Parts and those Materials) marked by asterisks (**) in Appendix B.

Military standard sampling plans will be in accordance with MIL-STD-105, 414, or Handbook 106, 107, and 108 and will identify by part number the NSP item to which the sampling plan is applicable.

Section 13
TRAINING AND CERTIFICATION

13.1 TRAINING

Specific attention will be directed to the training of all Quality Assurance personnel in their respective fields of activity. School facilities, and the procedures and materials used for training purposes, will be approved by MSFC/QA prior to use. Key Quality Assurance individuals, including all departmental and group supervision, will be thoroughly indoctrinated in MSFC quality policies for background application to the RIFT Program.

Programs will be initiated and maintained by Quality Assurance for the purpose of training selected personnel from the Engineering, Procurement, and Manufacturing organizations that contribute to product quality. Audio and visual training aids will be used when beneficial and practical, as well as poster displays, to maintain quality and reliability consciousness throughout all NSP organizations. Appropriate tests will be given to measure individual progress in proficiency and to indicate the need for additional training.

Training programs for inspection personnel will include, but will not be limited to, the following categories:

- Familiarization with RIFT components and assemblies
- Use of inspection and test equipment, quality control procedures, and inspection facilities
- Familiarization with manufacturing control procedures
- Familiarization with proper material handling techniques, storage, packaging, and shipping procedures

- Importance of cleanliness at all times
- Importance of accurate documentation and the maintenance of legible records
- Emphasis on the reduction of human errors by continued training

A Quality Assurance procedure to govern the establishment of a training program will be issued when the RIFT Program design requirements are more fully detailed. This procedure will follow the general format of the LMSC procedures now being used and will include training features dictated by RIFT vehicle-design characteristics.

13.2 CERTIFICATION

Training programs will be established which will encompass courses that have been reviewed by MSFC; these courses will be used to the maximum extent possible for the certification of personnel in the following areas:

- Radiographic Inspection
- Dye-Penetrant Inspection
- Magnetic-Particle Inspection
- Ultrasonic Inspection
- Soldering Techniques
- Fusion and Resistance Welding
- Electrical Wiring Methods
- Adhesive-Bonding Techniques

All personnel who have satisfactorily completed training courses in the aforementioned fields will be certified by test as being proficient and will be furnished with suitable evidence of certification to be carried on his person. Records will be maintained by the Quality Assurance organization of all certified personnel. These records will indicate dates for certification and recertification and any requirement for additional training, if tests show such training is necessary.

Section 14
DATA COLLECTION AND REPORTING

14.1 GENERAL DESCRIPTION

Collection, analysis, and evaluation of all malfunction, failure, and quality data resulting from tests, inspections, and usage of NSP products shall be the responsibility of Test and Product Assurance. This responsibility is distributed through all operating organizations. (See Fig. 2-1.)

The reasons for collecting and analyzing data are outlined in NPC 200-2, Quality Program Provisions for Space System Contractors, Para. 14.1, and the methods of accomplishment will be by inspecting, testing, recording, collecting, reporting, and analyzing. The technique used will be to plan the methods and write, audit, and correct procedures on the basis of overall program effectivity.

Records of product quality or usage data will be collected and transmitted to the NSP Engineering Data Center from Test Bases, Manufacturing, Procurement, Inspection, and Reliability Engineering. Data will be accumulated, analyzed, and provided in report form to those organizations interested in interpreting the reports and taking appropriate action.

Also, the NSP Engineering Data Center will provide statistical services to other NSP organizations and coordinate all Automatic Data Acquisition (ADA) system requirements. The ADA system ties in the entire Lockheed Missiles & Space Company system complex, thus making data, such as quality records from other projects, available to RIFT.

14.2 DATA REPORTING

Records are being maintained of inspections and tests performed during development, fabrication, and assembly operations. These records are available to the cognizant NASA representative for examination.

A Monthly Quality Status Report will include summaries and compilations of this information to provide necessary analyses and status reports. This report will be forwarded to the requesting MSFC organization for information, as required by Appendix B, NPC 200-2.

Unless otherwise directed, data reported on all laboratory and experimental tests, evaluations, and failure analysis will be kept on file and properly referenced to the part, component, or system concerned. Such data will include part number, component or system identification, test purpose, conditions and type of test, description of failures, numerical test results, photographs, graphs, operating test time, and recommendations.

In addition to the Monthly Quality Status Report, a narrative end-item report will be prepared and submitted for each end-item required by the contract schedule. This report will include the model and serial number of the end-item and will furnish all of the pertinent information directed in NPC 200-2, para. 14.2.4.

14.3 OPERATIONAL DATA

The responsibility for collection, reduction, and dissemination of operational data will be shared by NSP Stage Test and Test Base Quality Assurance organizations and will be coordinated through the NSP Engineering Data Center.

The operational information and data will be included in the vehicle log books and will include, but not be limited to, the following items:

- Acceptance Test Procedures and Test Reports including a complete description of operation or mission objectives

- Inspection Procedures and Test Reports
- Record of Variations or Waivers
- Operation – Time Cycle Logs for Limited Operational Life Items, Limited Calender Life Items, and Controlled Operational Life Items
- Maintenance and Operating Records and Log Books to include:
    (1) Serial numbers of all replaceable subassemblies in the delivered assembly
    (2) Complete removal and replacement record for all replaceable assemblies, and reasons for replacements
    (3) List of modifications resulting in current configuration
    (4) Justification for, and approval of, all listed deviations, waivers, and modifications
    (5) Running time or cycles and estimated life of components
- Instrumentation Data – Reduced
- Reduced Data from all recording device tapes, charts, etc.
- Failure Mode and Analysis Data to include:
    (1) Identification of component or equipment that failed
    (2) Identification of subsystem or system involved
    (3) Conditions at time-of-failure
    (4) Operating time at failure
    (5) Date and location of failure
    (6) How failure was observed
    (7) Recommended corrective action and follow-up

Section 15
CORRECTIVE ACTION

15.1 GENERAL DESCRIPTION

Corrective action will be accomplished as outlined below and in conjunction with the Material Review Board (MRB) activities shown in NSP PA Procedure No. 4 and "Malfunction Analysis and Corrective Action Flow Chart," PA No. 100.

The corrective action will be initiated at an early date in the manufacturing cycle for each vehicle. A team of Manufacturing and Quality Assurance personnel will be assigned to each vehicle; this team will have corrective action responsibilities with priority (throughout the life of the vehicle) over the team members normal duties. Corrective action recommendations for discrepant GFP will be referred to the local MSFC/QA Representative for necessary action.

15.2 OBJECTIVES

The primary objectives of the corrective action team are as follows:

- To review failure analyses and initiate prompt corrective action as indicated by MRB decisions
- To preclude recurrence of any deficiency
- To exercise "stop work" authority when circumstances warrant
- To notify affected organizations that corrective action is necessary

All corrective action measures will be documented, and pertinent data will be extracted for transmission to NSP management and for inclusion in quality reports to MSFC.

Section 16
QUALITY PROGRAM PLAN PERFORMANCE AUDIT

16.1 GENERAL DESCRIPTION

The NSP Quality Assurance organization will initiate and direct quality performance audits at random unannounced intervals. These audits will be conducted by an impartial team of Quality Assurance personnel who are familiar with procedures but have no direct responsibilities in the areas being audited. Each performance audit will include, but will not be limited to, the following operations:

- A reinspection of work previously accepted in the area being audited
- A check for familiarity with document completion procedures
- A familiarity check of inspection procedures and manufacturing processes
- A review of inspection tool use and calibration effectivity
- A review to determine training requirements
- A check of the adequacy of inspection facilities
- A review of the legibility of inspection reports and records
- A review of rejection records and corrective action results
- An inspection of area cleanliness and housekeeping

Specific activities that will be subjected to performance audits are the following:

(1) Engineering Document Review
(2) Procurement
(3) Receiving Inspection
(4) Functional Test
(5) Material Stores
(6) Fabrication
(7) Inspection
(8) Process Control

(9) Assembly Inspection
(10) Test Operations
(11) Shipping Inspection
(12) Transportation
(13) Laboratory Operations
(14) Tool Inspection
(15) Instrument Calibration

16.2 QUALITY PERFORMANCE AUDIT REPORT

A report containing the results of each audit will be issued to all affected organizations. Follow-up reviews of audited areas will be made at frequent intervals until all deficiencies revealed by the audit have been corrected. Copies of these reports will be submitted to MSFC, and appropriate records will be maintained as a measure of organization, personnel, and procedure efficiency. Analyses of audit results will be performed on a continuing basis to provide a means for measuring program effectiveness and for notifying NSP management and MSFC of the quality levels that are being attained.

Appendix A

LIST OF PRODUCT ASSURANCE PROCEDURES PECULIAR TO RIFT

11.12-401	RIFT Material Review Board
11.44-410	RIFT Raw Material Process Control

Appendix B*

NON-SERIALIZED PARTS AND MATERIALS

Parts**	Materials
Rivets	Shim Stock**
Lock Bolts	Safety Wire**
Hi-Shear Rivets	Safety Chain
Cotter Pins	Cable Conduit
Packing Rings	Insulation
Washers	Wire Screen
Terminals	Typing Tape
Bushings/Spacers	Weld Rod
Grommets	Cements/Adhesives
Inserts	Paints
	Seal Compounds

*Ref. Section 4.3.
**Typical miscellaneous small parts (MSP)

Appendix C
PRODUCT ASSURANCE STANDARD

("Supplier Product Assurance System Requirements," PA STD 5-1.0, dated 18 Nov 1963)

PRODUCT ASSURANCE STANDARD

SUPPLIER PRODUCT ASSURANCE
SYSTEM REQUIREMENTS

PA STD 5-1.0
Page 1 of 7
Dated 18 NOV 1963

Product Assurance Standards

Manager, Quality Engineering

1. PURPOSE AND SCOPE

1.1 To establish Product (Reliability and Quality) Assurance requirements governing Lockheed procurement. To provide a means of specifying on procurement documents the Supplier's responsibility to assure that materials or services conform to Design, Reliability, Quality and other Procurement document requirements.

1.2 Supplementary Product Assurance requirements shall be indicated in the subcontract/purchase order when applicable.

2. BASIC SYSTEM REQUIREMENTS

2.1 The supplier shall maintain a Product Assurance System that as a minimum meets all of the requirements of this document. Written descriptions of policy, procedures and instructions shall define internal responsibility for the control of quality and/or reliability and are subject to Lockheed approval.

2.2 The Product Assurance organization shall be on an organizational level which ensures unimpeded control and authority over all quality requirements and for the solution of inadequacies. The system shall include an inspection capability adequate in skill and numbers to assure early detection and correction of nonconforming material. It shall provide all in-process controls necessary to maintain conformance to design requirements, product quality and reliability.

2.3 The system shall provide assurance that an effective reliability program and controls will be established and maintained when required by the procurement documents. This may require planning, developing, integrating, implementing and monitoring throughout all phases of the procurement activity including, when required, the entire process of design, manufacturing, testing, storage, packaging, handling, shipping and maintenance. Certain phases of the reliability program, including, but not limited to: testing, supplier control, failure analysis and feed-back and data reporting which are common to both reliability and quality assurance shall be implemented as an integral part of the Product Assurance System.

2.4 The supplier shall maintain and be familiar with applicable Lockheed drawings, specifications and other procurement documents. The supplier shall understand and agree to the provisions of these documents prior to proceeding with execution of the contract.

2.5 The system shall provide for adequate placement and training of inspection and other personnel who have an effect upon or are responsible for determining

product quality. Formal certification/qualification of personnel for processes, materials or other operations requiring special skills or training shall be maintained.

3. CONFIGURATION CONTROL

3.1 During the Purchase Order/Subcontract life, changes to drawings, specifications, test procedures, and changes in identification, shall be controlled and incorporated at the effectivity points specified or approved by Lockheed.

3.2 Supplier proposed changes to Lockheed design or Lockheed approved documentation, hardware, or methods shall be submitted to Lockheed Procurement. Written approval by cognizant design organizations shall be obtained prior to change incorporation. Records shall be maintained showing approval and point of incorporation of such changes.

3.3 Suppliers shall not incorporate any Lockheed originated changes to design, specifications, methods etc. unless authorized in writing by Lockheed Procurement.

4. CONTROL OF SUPPLIERS

4.1 The supplier shall be responsible for the conformance of all items procured from every tier of his sub-suppliers to the applicable Lockheed procurement requirements. The supplier shall assure that these requirements are included in his procurement documents. The supplier's quality system shall provide a method by which the sub-supplier's conformance to these requirements can be verified and shall include a program for failure and deficiency feedback to his suppliers.

5. SURVEILLANCE AND SOURCE INSPECTION REQUIREMENTS

5.1 Lockheed reserves the right to assign Product Assurance Representatives at the supplier's facilities or at lower tier sub-suppliers. Such Representatives shall conduct and maintain such surveillance as necessary to ensure quality and reliability. The supplier is required to provide Lockheed Product Assurance Representatives with reasonable facilities, equipment and access to all areas essential to the proper conduct of the aforementioned activity throughout all phases of manufacturing, testing, packaging and shipping applicable to the contract.

5.2 The supplier will facilitate required Lockheed or Government Source Inspection by providing the latest specifications, records and applicable inspection documents to the Lockheed or Government Representative(s). When Government Source inspection is required, the supplier shall include the appropriate statement on his procurement documents. Evidence of source inspection shall accompany the shipment. Lockheed Product Assurance or Government Representative(s) have the right to withhold permission to ship non-conforming materials or supplies.

5.3 Source acceptance by Lockheed Product Assurance or Government Representative(s) shall not be construed: (i) as constituting final acceptance or (ii) as relieving the supplier of any responsibility in meeting contract requirements. Final acceptance of deliverable items shall be accomplished in the manner and at the place specified in the procurement documents.

6. SUPPLIER'S INCOMING MATERIAL CONTROL

6.1 Supplier-procured parts and material and Government Furnished Equipment to be used on Lockheed items shall be subject to a Receiving Inspection acceptance system that will assure conformance to Lockheed drawing and specification requirements.

6.2 The supplier shall provide procedures for positive control of all incoming supplies pending completion of required tests or receipt of necessary test reports including segregation of nonconforming materials and supplies. Limited life items, shall be identified, stored, disbursed and controlled as required by applicable specifications and drawings. Specific Lockheed authorization is required before substitution of specified materials.

6.3 Government furnished equipment found to be in non-conformance or damaged shall be withheld from use, protected from further damage, and promptly reported to the cognizant Government agency.

7. IN-PROCESS, FINAL INSPECTIONS AND TESTS

7.1 The supplier shall perform the necessary inspections and tests, in addition to those required by applicable drawings and specifications to ensure conformity to the latest applicable drawings and specifications with respect to all details and requirements. Receiving, processing, fabrication, assembly and shipping inspection and tests shall be performed as required during the manufacturing cycle.

7.2 Inspections which cannot be readily performed in the end product shall be performed at appropriate in-process stages of manufacture. Prior to release to the Lockheed or the Government representative, or shipment of items, the supplier shall perform final acceptance inspection upon 100% of the items supplied unless otherwise authorized.

8. STATISTICAL QUALITY CONTROL

8.1 Any inspection sampling method (less than 100%) shall comply with MIL-STD-105, MIL-STD-414, or other sound mathematical methods. The plans utilized must afford reliable assurance of acceptable quality levels. Procedures and sampling levels shall be authorized by Lockheed prior to their adoption. A system of failure feedback shall be maintained to achieve satisfactory results.

9. MODIFICATIONS AND REPAIRS TO RETURNED ARTICLES

9.1 All modifications or repairs

performed on any returned item shall be accomplished only after confirmation by Purchase Order and in accordance with Lockheed approved Engineering and Product Assurance procedures.

9.2 Prior to shipping authorized modified or repaired units to Lockheed, the supplier shall assure that such units meet all required tests and established standards of quality and workmanship unless otherwise authorized by Lockheed. Modified or repaired items shall be identified as such prior to shipment.

10. SPECIAL PROCESSES AND NONDESTRUCTIVE TESTING

10.1 Chemical, metallurgical, nondestructive tests and other critical processes for which quality cannot be assured by inspection after completion shall be qualified/certified before use and closely controlled during production. Operating and inspection personnel and process procedures shall be certified when required and records maintained as proof of constant process control. All qualification or certification shall be in accordance with the requirements of the specifications and standards imposed by the procurement documents, modified only with prior Lockheed approval.

10.2 Qualifications and certifications of special processes and personnel are required prior to usage on Lockheed procured items. The supplier shall provide samples and/or test data as required by Lockheed for the qualification and certification approval. Periodic surveillances will be performed by Lockheed Supplier Product Assurance.

10.3 Suppliers of deliverable end items incorporating or using special processes are responsible for establishing the qualification or certification status of all facilities and personnel performing these processes through all tiers of his suppliers. Objective evidence of the qualification or certification shall be available to Lockheed Representatives at sub tier supplier's facilities. Lockheed reserves the right of disapproval of any processes where adequacy of control and certification cannot be demonstrated.

10.4 Qualification/certification and maintenance of status is required of the following, but not limited to, special processes, heat treatment; welding; fusion and resistance; clean rooms; brazing: torch, furnace, dip and induction; soldering: hand, flow, and dip; plating: electro and electroless; coatings: chemical film, anodic, dry film lubricant, ceramic and metallic; inspection: radiographic, magnetic, dye and fluorescent penetrant, ultrasonic and eddy current; and foundries: forging and casting. Material and process control is required on, but not limited to the following: plastics fabrication, painting, potting, molding, sealing, bonding, encapsulation and cleaning: chemical and ultrasonic.

11. MEASURING AND TEST EQUIPMENT CONTROL

11.1 The supplier shall provide and maintain gages, instruments and test equipment necessary to inspect and to assure that all supplies conform to contract requirements.

11.2 Measuring and test equipment shall receive scheduled recalibrations with measurement standards, which are in turn periodically calibrated to standards traceable to the National Bureau of Standards. Records for conclusive evidence that control is maintained shall be provided. Equipment shall be identified to show calibration status, limits, and recalibration due date. Production tooling, jigs or fixtures used as inspection media shall be initially inspected ar ' proven. Scheduled periodic reinspection shall be performed to maintain initial accuracies.

12. FIRST ARTICLE ACCEPTANCE

12.1 First Article Acceptance by Lockheed Product Assurance may be required by the contract. When this requirement is invoked, a first article report which records actual measurements of specifications/blueprint criteria and dimensions, acceptance test reports and other applicable data shall accompany the submitted unit. Acceptance of this unit by Lockheed Product Assurance is required before authorization to proceed with production or shipment of remaining units is given by procurement. First Article Acceptance indicates that only the submitted unit meets specification and blueprint requirements and does not imply acceptance of future articles or waiver of any procurement requirements with respect to future articles.

13. IDENTIFICATION

13.1 Parts and assemblies shall be identified to Lockheed requirements as specified by drawing or specification. If a Lockheed number is not applicable, the supplier's part number shall be used. In all cases, the supplier's identification shall be evident. If practical, or when contractually required, parts shall be identified with a serial number. Supplies shall be identified as to inspection status throughout the manufacturing cycle. Individual stamps are required to designate final acceptance and any other operations requiring specific approval identification such as, but not limited to: pressure test, proof load, magnetic particle inspection, radiographic inspection, hardness tests, penetrant inspection, ultrasonic inspection, welding, etc. Assemblies having components requiring individual approval stamps shall have these stamps applied next to the top assembly part number. Stamps shall be applied in such a manner as to prevent damage or compromise quality.

14. NON-CONFORMING MATERIAL AND CORRECTIVE ACTION

14.1 The supplier shall provide written procedures for the control, segregation, identification and disposition of nonconforming supplies. Provisions for timely corrective action shall be part of such procedures. This

action shall include preventative measures as well as correction of conditions which have or may cause defective or sub-standard material, parts or services. Proper storage to prevent degradation or damage to withheld material shall be provided. Material Review requests for preliminary dispositions of nonconforming articles shall be submitted to Lockheed on forms as specified by Lockheed. Written dispositions must be obtained from Lockheed according to established procedures prior to any delivery of the affected articles. Reference shall be made on the Suppliers' shipping documents which have authorized shipment of nonconforming articles.

14.2 Any units or lots determined by Lockheed to be in nonconformance may be returned to the supplier. Lockheed shall not be obligated to determine nonconforming receipts by 100% inspection. Unless otherwise authorized in writing by Lockheed, the supplier shall furnish Lockheed only articles which are in complete compliance with contract requirements.

15. WORKMANSHIP

15.1 Sustained emphasis on full application of production skills and on the resulting quality meeting the design intent as well as contract requirements, shall be maintained and enforced by intensive inspectio Product characteristics and conditions which are implied rather than specified shall be given all practical consideration.

15.2 Workmanship standards are specified on design drawings or referenced applicable documents. Those not stated as design requirements are defined in Lockheed Product Assurance Standards (PA STD) and shall govern when specified in the contract.

16. PACKAGING, PRESERVATION AND SHIPPING

16.1 The supplier shall maintain adequate controls to assure accomplishment of the preservation, packaging, packing and shipping requirements of the contract. The use of commercial practices shall not relieve the supplier of the responsibility for packaging in a manner that will assure the receipt of supplies at Lockheed in an acceptable condition.

16.2 Objective evidence of conformance, such as, but not limited to test reports and certificates of conformance, including in-process inspection reports, shall accompany each shipment of supplies when required by contract or specification. When required by the procurement document or by separate request, drawings or catalogs, sufficiently definitive to provide receiving inspection criteria, shall be delivered to Lockheed prior to, or concurrent with shipment of supplier proprietary items. Items fabricated from Lockheed-furnished material shall be accompanied by a statement to that effect and shall include a clause that no unauthorized substitution of material was made.

17. RECORDS OF INSPECTIONS AND TESTS

17.1 The supplier shall maintain records of all required inspections and tests. The records shall provide evidence that all required inspections and tests have been performed. These records shall be filed and stored by the supplier for 6 years unless otherwise specified by contractual requirements and shall be available for review by Lockheed and/or the cognizant Government representative(s). Copies shall be furnished to Lockheed as required.

17.2 The supplier shall maintain records of approvals of changes to Lockheed Procurement Documents, Company Procedures, Forms, Design Review Reports, Acceptance Criteria, Parts List, etc. which required Lockheed approval as indicated in the subcontract. Evidence of such approvals will be made available to Lockheed representatives upon request.

18. INQUIRIES

18.1 Inquiries regarding this policy shall be directed to Lockheed Product Assurance through the Lockheed Procurement Organization.

Prepared by H. A. Luck, Quality Engineering

LOCKHEED MISSILES & SPACE COMPANY